High Quality Math Editing & Display in Office 12

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Office Authoring Services

Overview

- 8 math infrastructures inside and outside of Microsoft enable better math display/editing
- New math edit/display environment
- Provide infrastructure for editing programs to support built-up formulas
- Provide ability to interchange formulae with popular mathematics programs such as Mathematica, MathCad and Matlab
- Incorporate into Word 12, OneNote 2.0, RichEdit, PowerPoint, IE, ...

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Collaborators

- Math layout handler: Eliyezer Kohen, Victor Kozyrev, Andrei Burago
- Word PM: Jennifer Michelstein
- New font: Mike Duggan, Geraldine Wade, Greg Hitchcock and Monotype
- OpenType: Sergei Malkin
- Devs/Test/PM of RichEdit, LineServices, Page/TableServices, Word, OneNote, Office Art
- Hand writing: MSR & MSRA
- Outside: Barbara Beeton, Asmus Freytag

Math Infrastructures

- [La]TeX: current tech-doc standards
- Unicode 4.0: includes ~2000 math symbols
- MathML 2.0: math K – 12 and beyond
- OpenType: special math tables
- New OpenType math font
- LineServices 4.0: math handler
- RichEdit 6.0: multilingual math edit engine
- MS Office environment, autocorrect

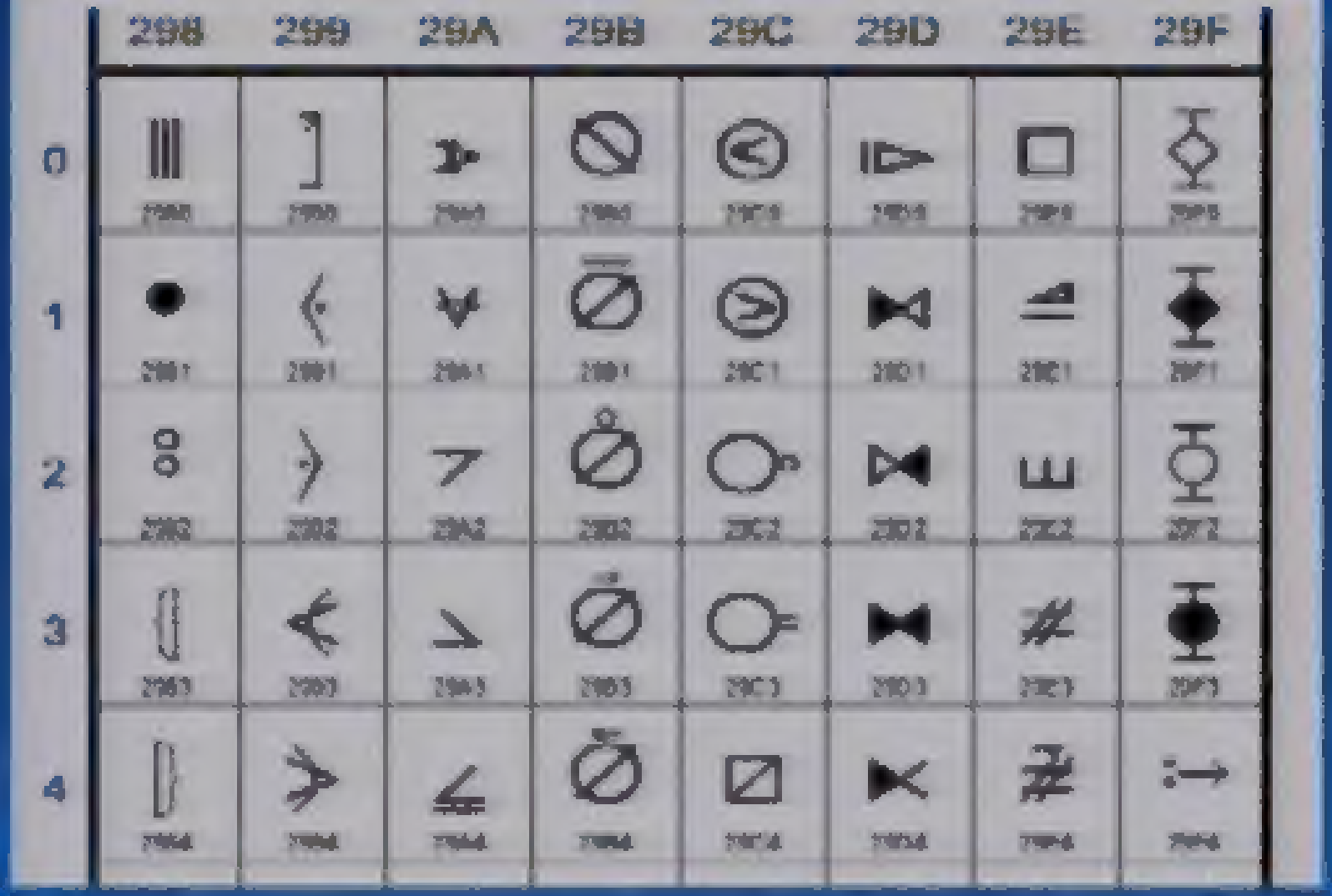
[La]TeX

- Widely used, high quality tech document preparation system
- Simple ASCII keyboard entry
- Usage and math typography are well documented
- Stable since 1986
- Complex scenarios are hard to manipulate
- Numerous dialects and macros complicate interchange

Unicode 4.0

- 340 math chars exist in ASCII, U+2200 block, arrows, combining marks
- 1016 math alphanumeric characters are in Unicode Plane 1 or Letterlike Symbols
- 591 new math symbols and operators are on BMP
- One math variant selector
- One new combining character (reverse solidus)
- New math characters were requested by STIX

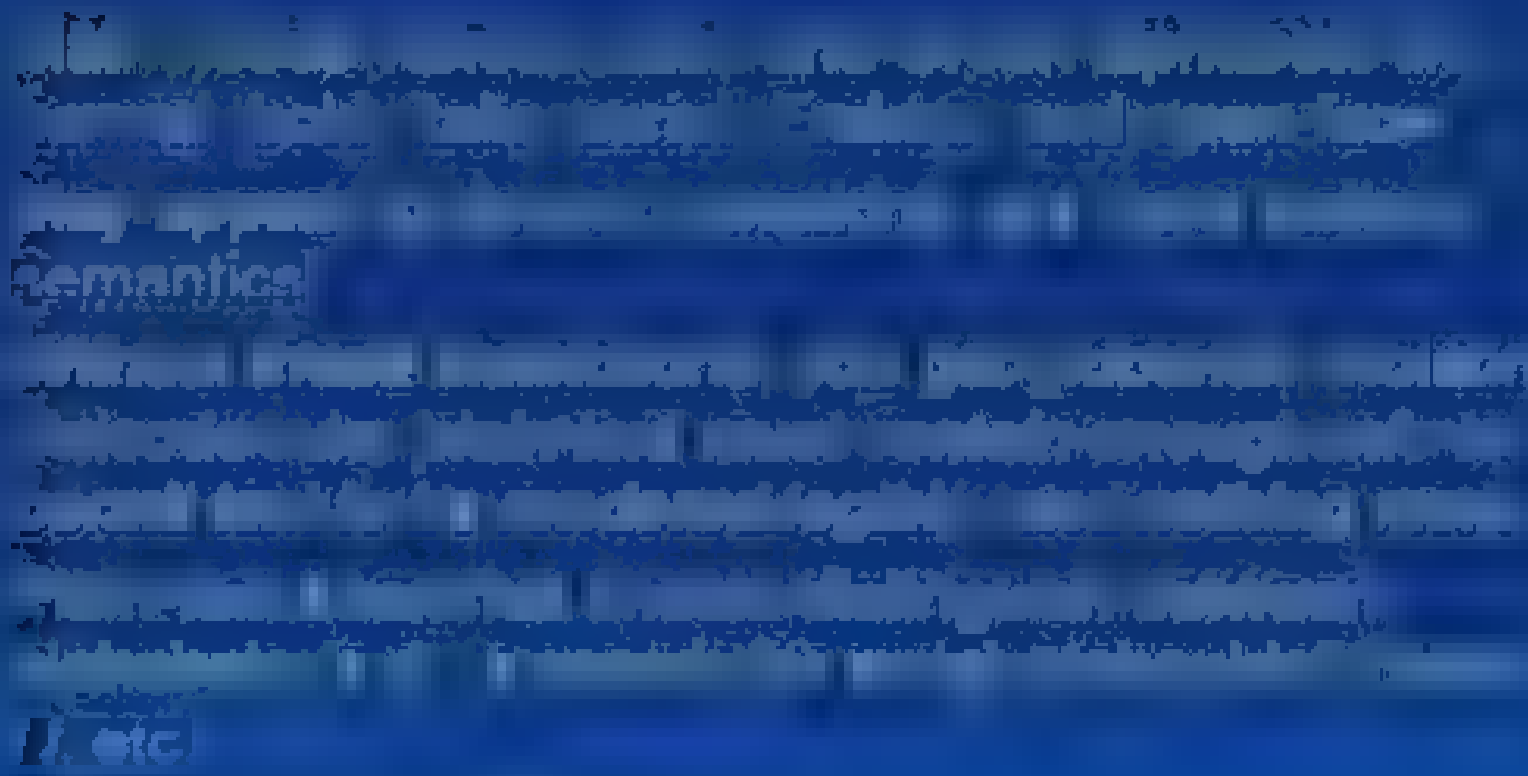
Extensive Math Symbols



Basic Set of Alphanumeric Characters

- Latin digits (0 - 9)
- Upper- & lowercase Latin letters (a - z, A - Z)
- Uppercase Greek letters Α - Ω plus the nabla ∇ and the variant of theta ϴ given by U+03F4
- Lowercase Greek letters α - ω plus the partial differential sign ∂ and glyph variants of ε, ϑ, κ, φ, ϱ, and ϖ
- Only unaccented forms of letters are used

Main Algorithm Structure



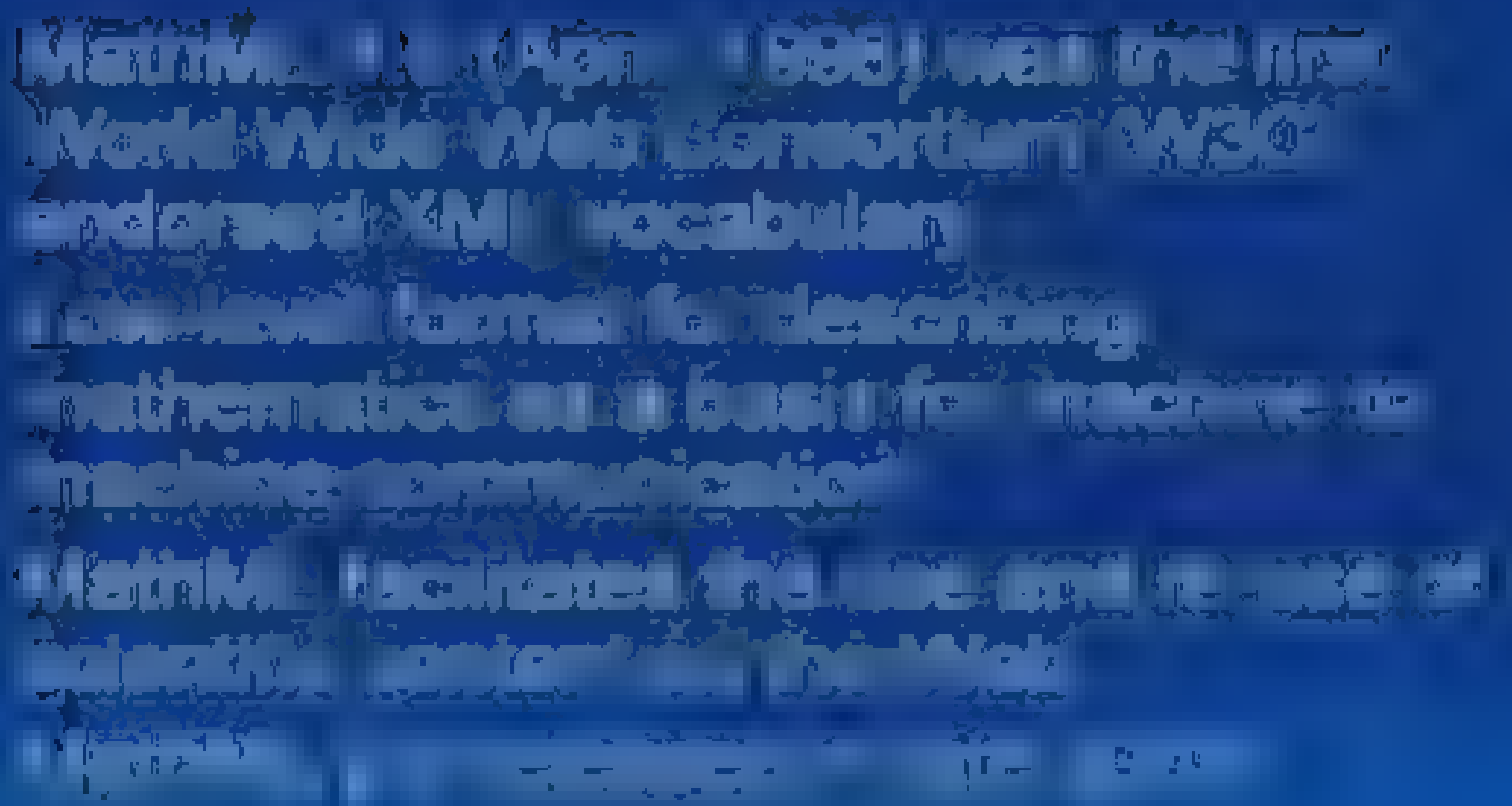
Legality Test

Unicode Plain Text

Unicode and Markup

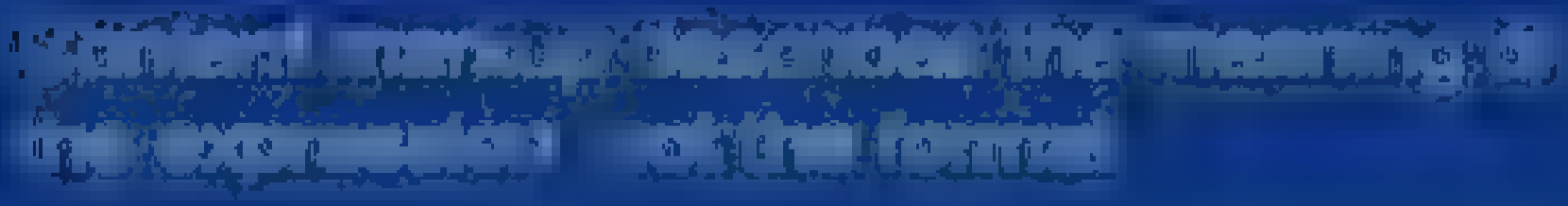
MathML: For the Rest of the Web

MathML



MathML Presentation Markup

MathML Content Markup



OpenType

Object Type Projection for Word Equations

V_1 ⟵ *not open type*

V_2 ⟵ *open type*

New Main Font

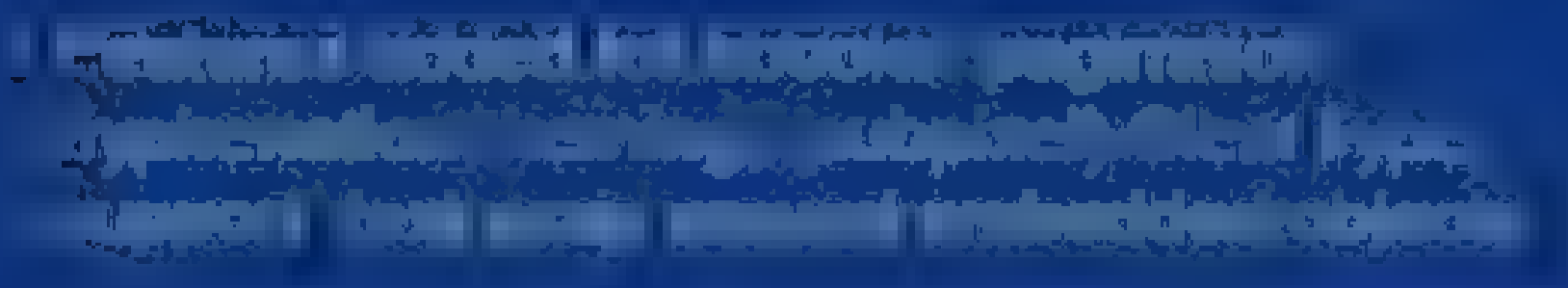
LineServices [illegible]

- Standard line layout component used by all major Microsoft text engines
- New math handler developed by Eliyezer Kohen, Victor Kozyrev, Andrei Burago
- Works with Page/Table Services [illegible] enables optimal line breaking algorithm
- Math [illegible]

RichEdit 6.0

Clients include

Some Painter Features



Some Further Features

Solar Flare Regions

Some Further Features

- line breaking

Other Components Used

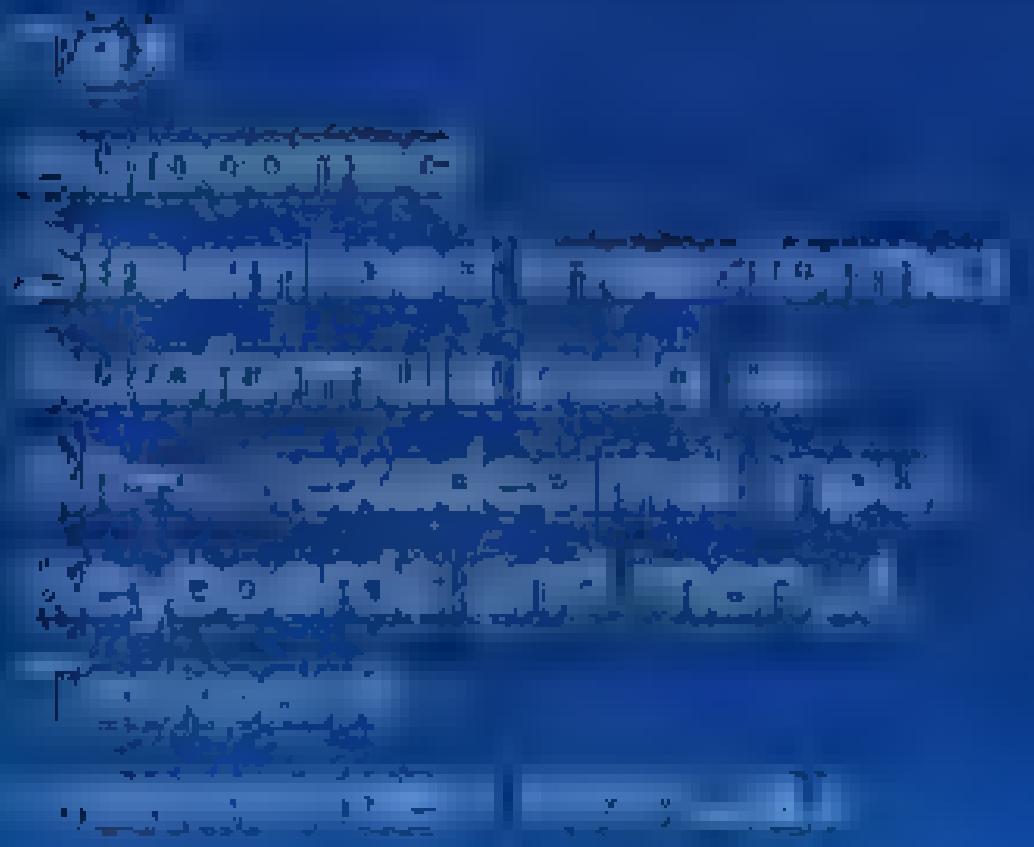
Other Components Used

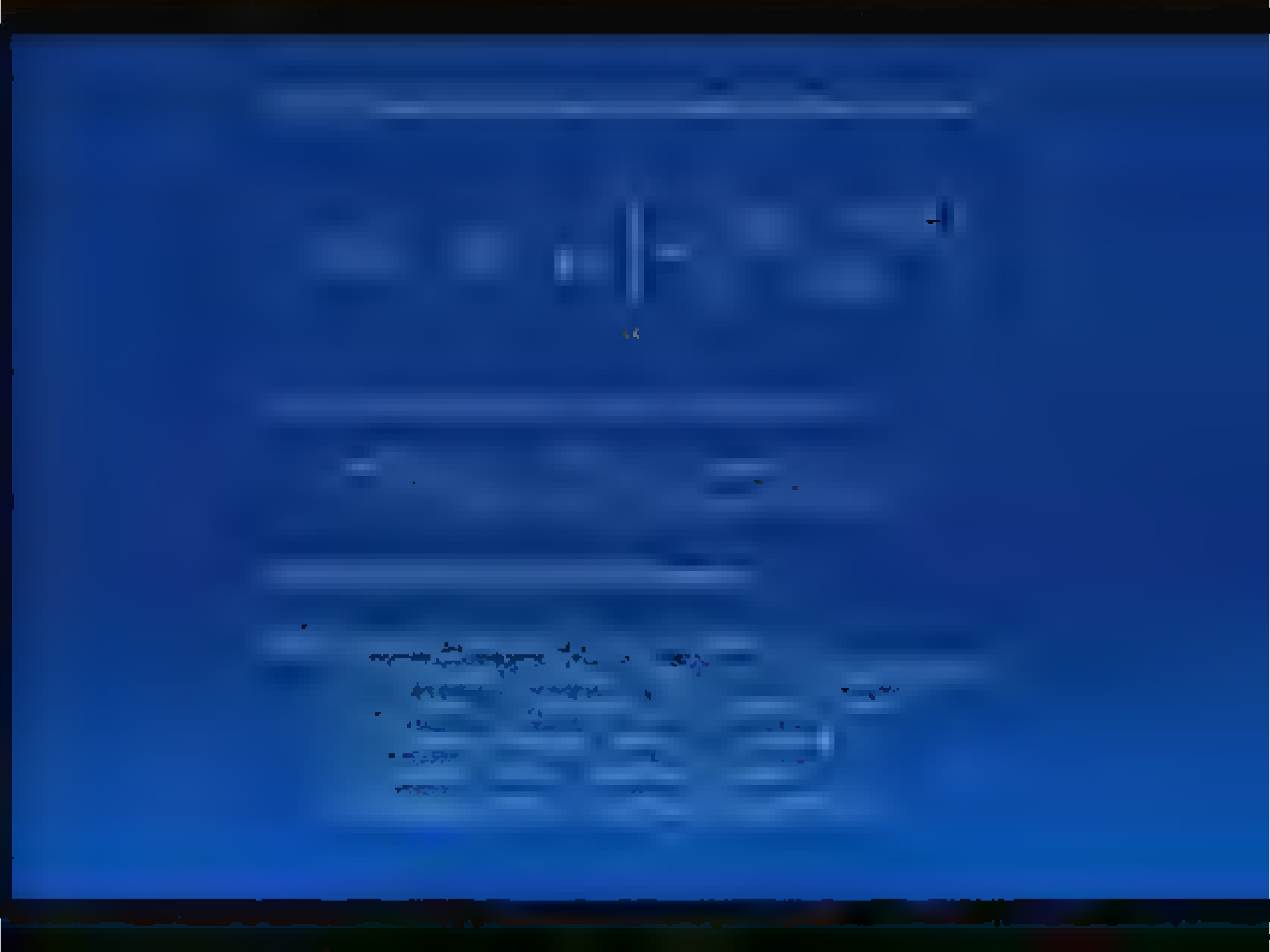
Main Display/Editing Model

Resistance

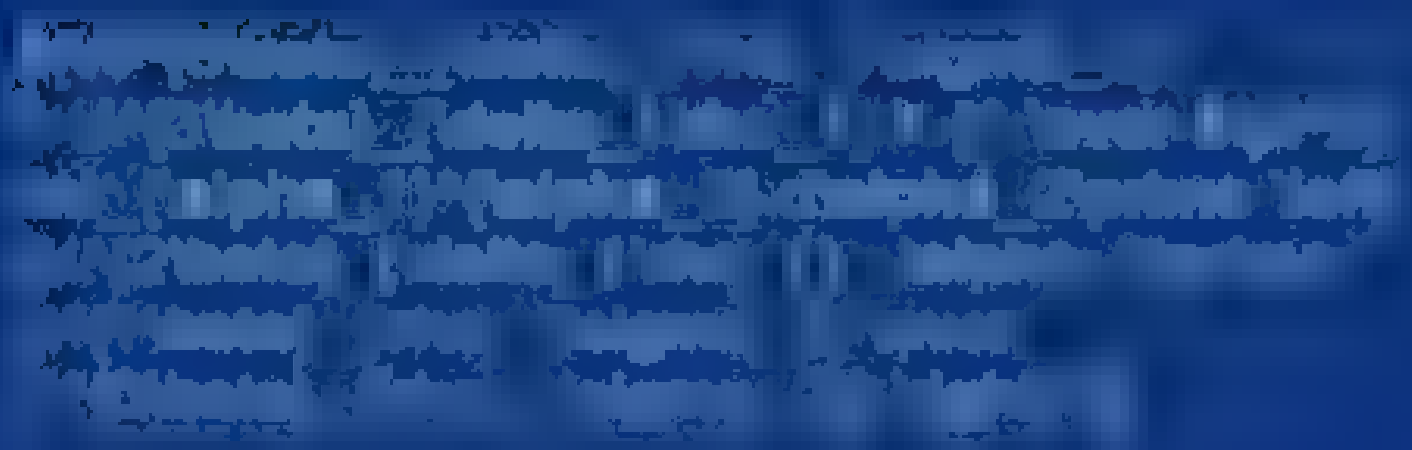
capability

Lapsur Methods





Untreated Text Example

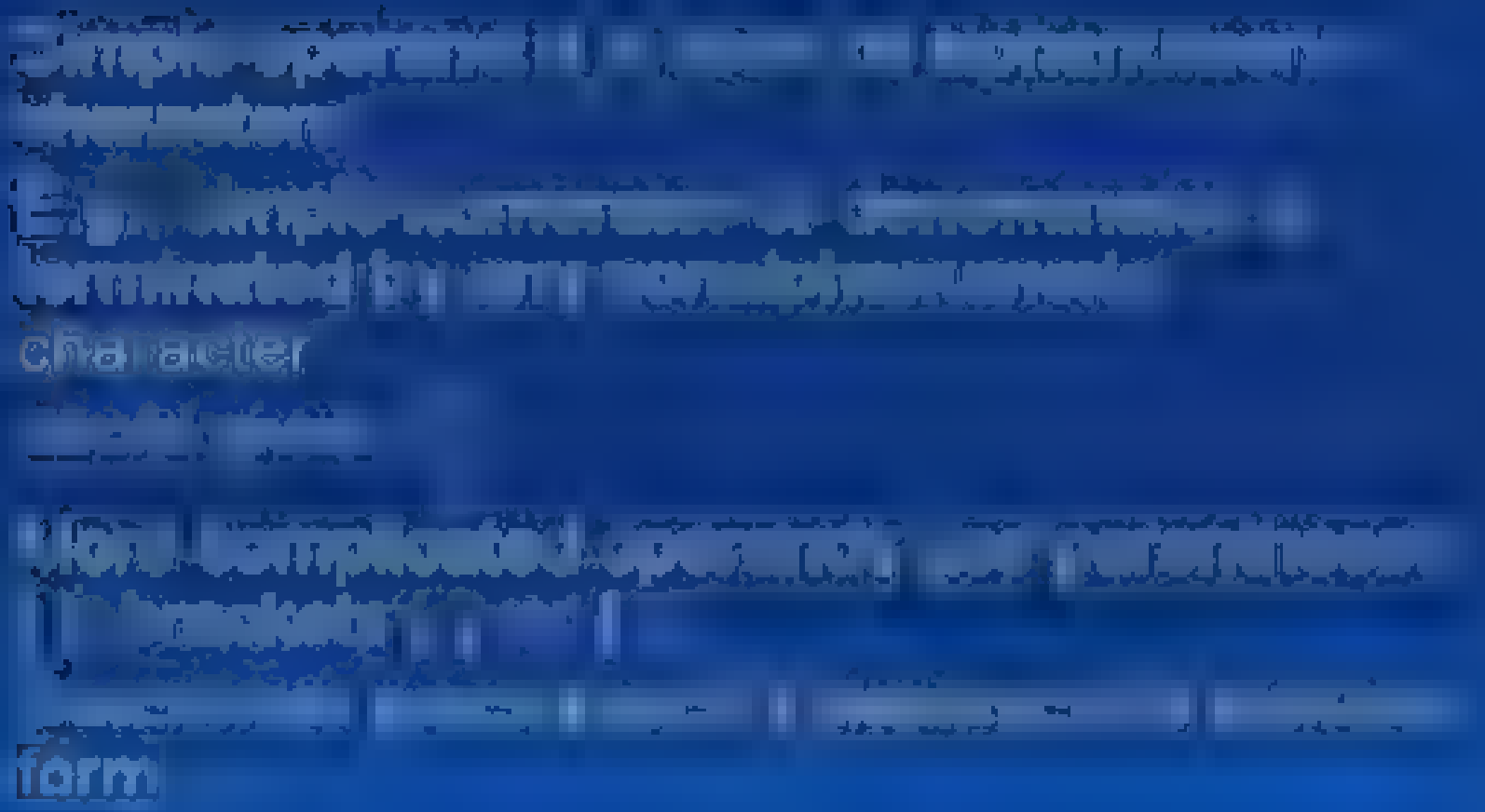


Symbol Entry

Hex to Unicode Input Method

Formula AutoBuildUp

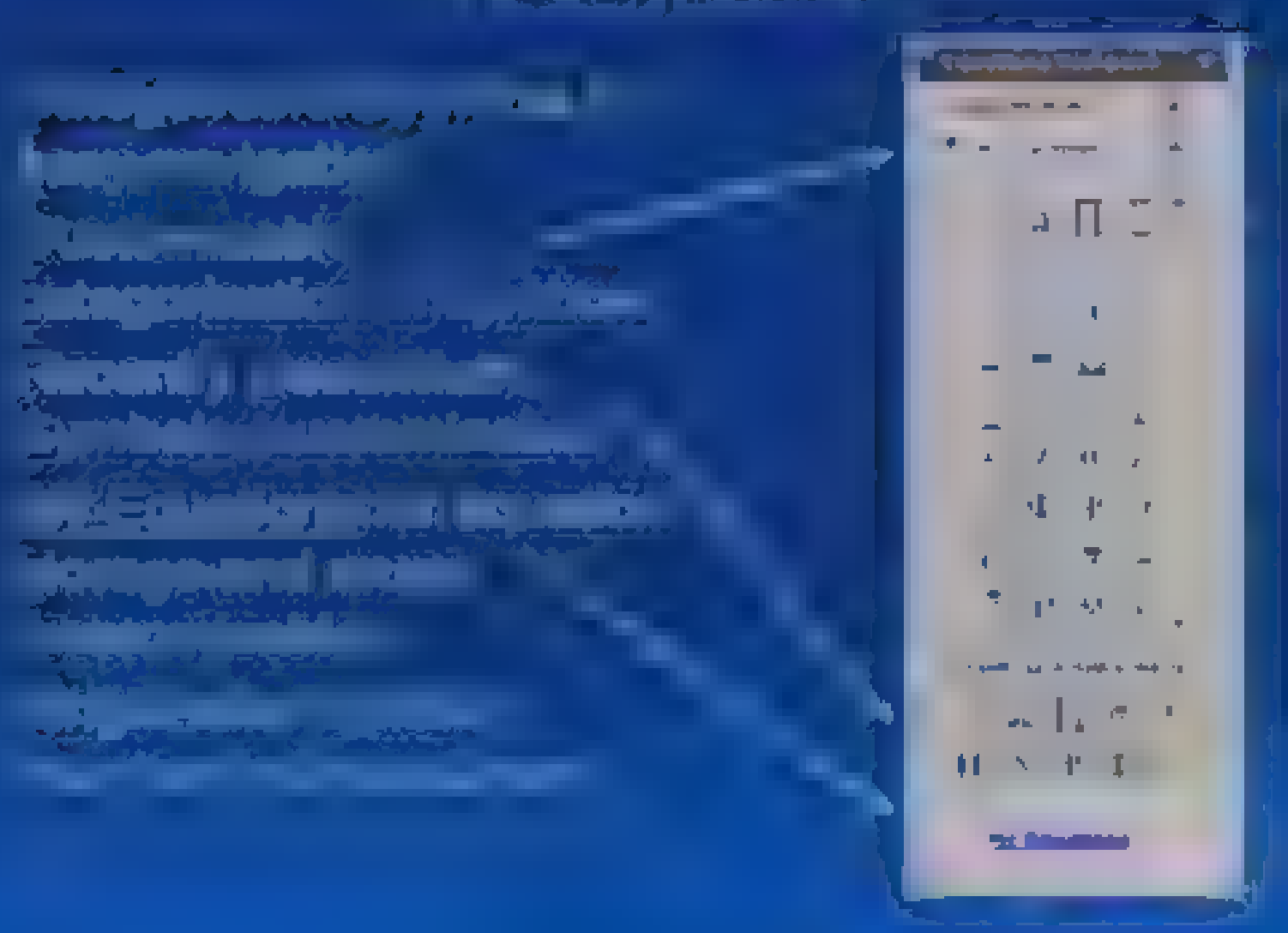
Literary Terms



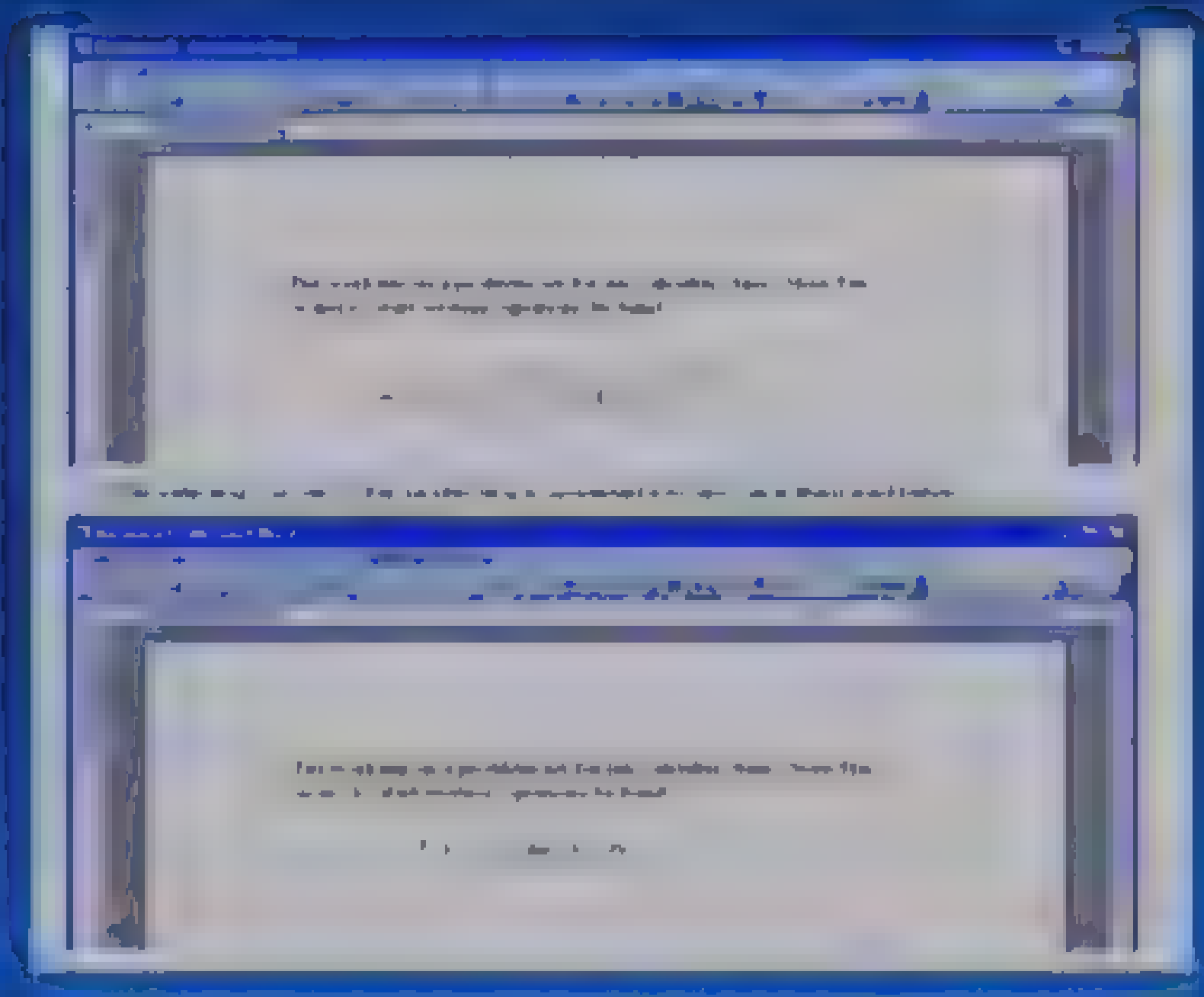
Linear format math (cont.)

Superstitions and Superstitions

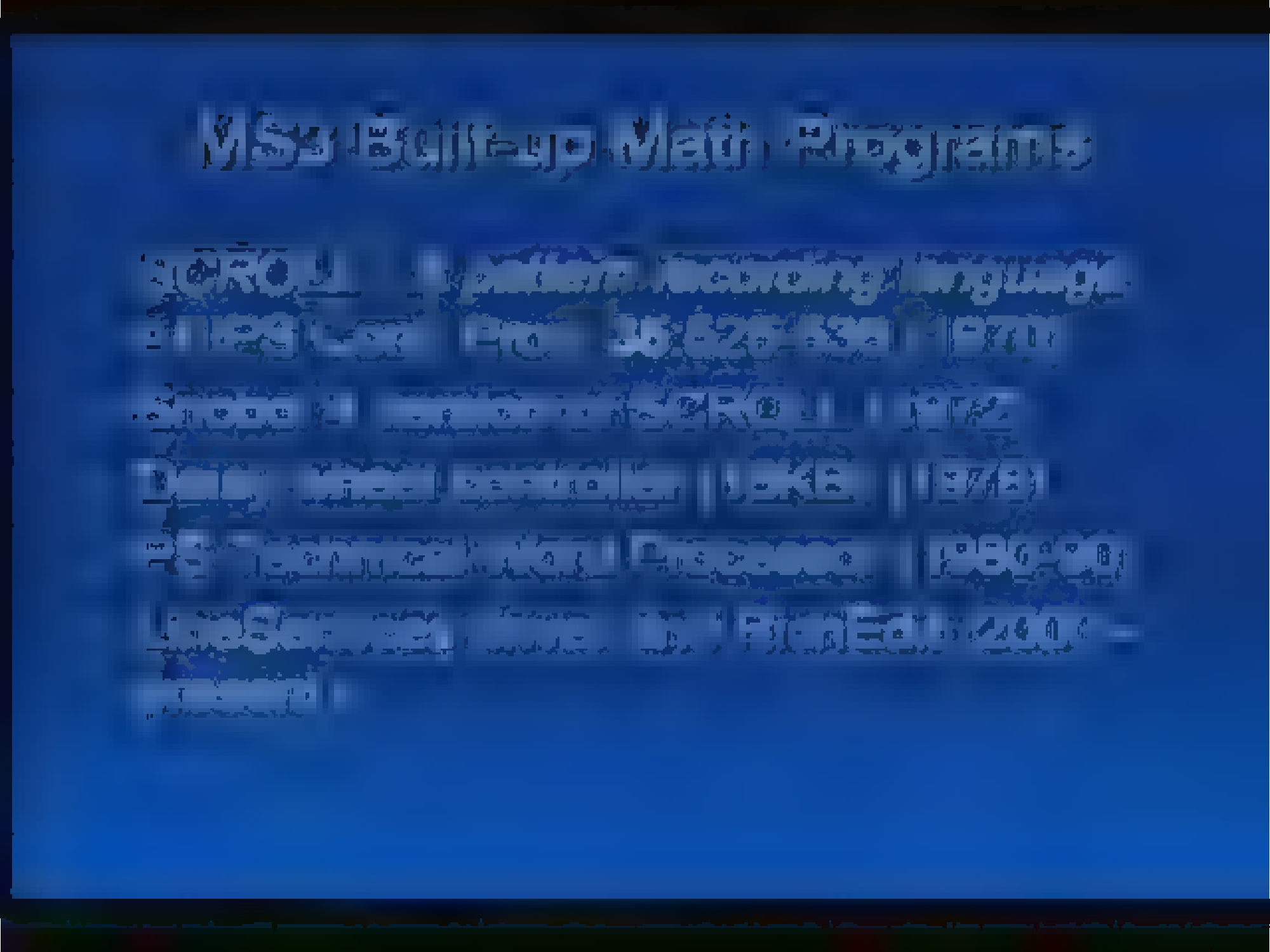
Taskpane



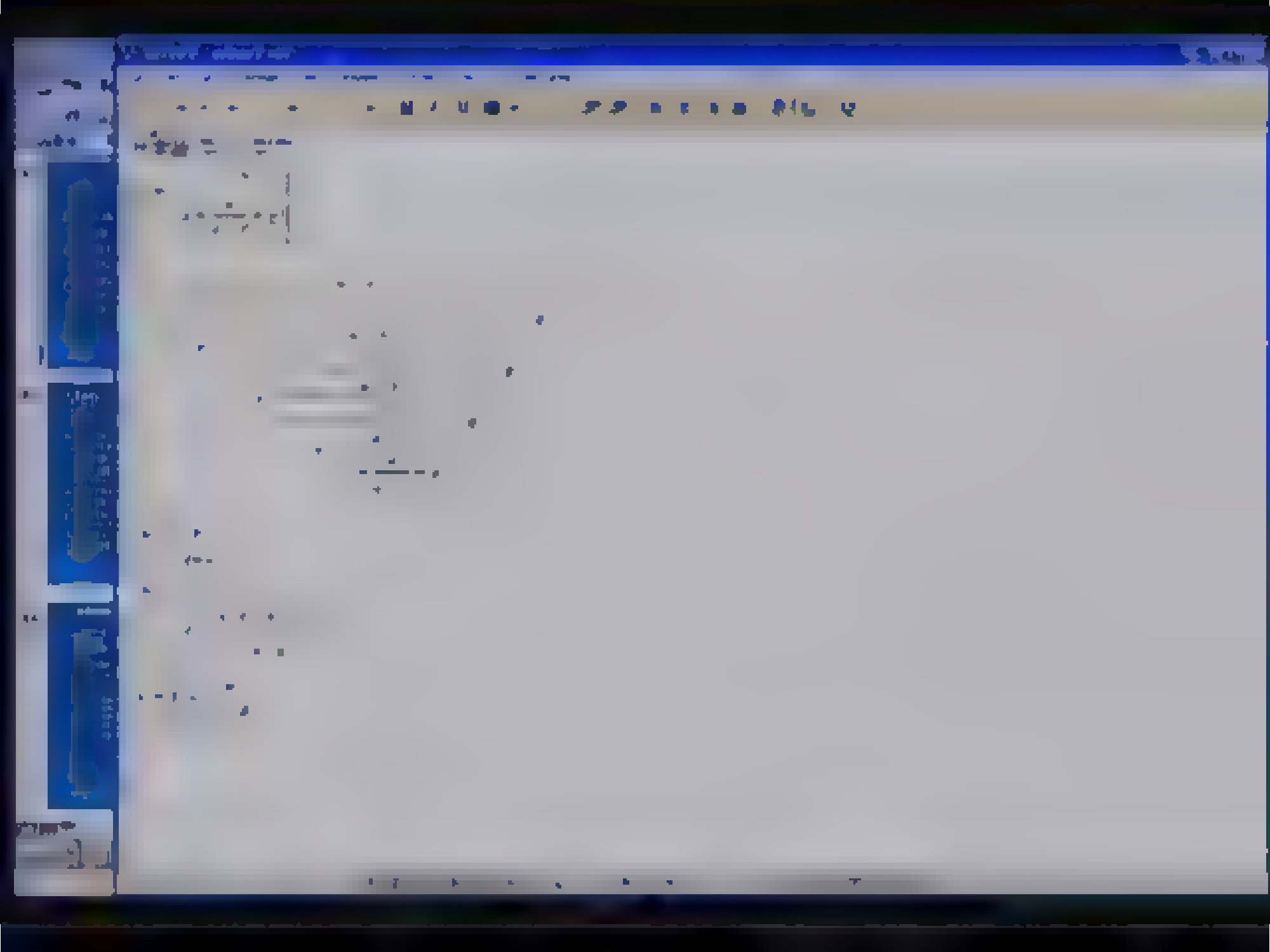
Handwritten Equations

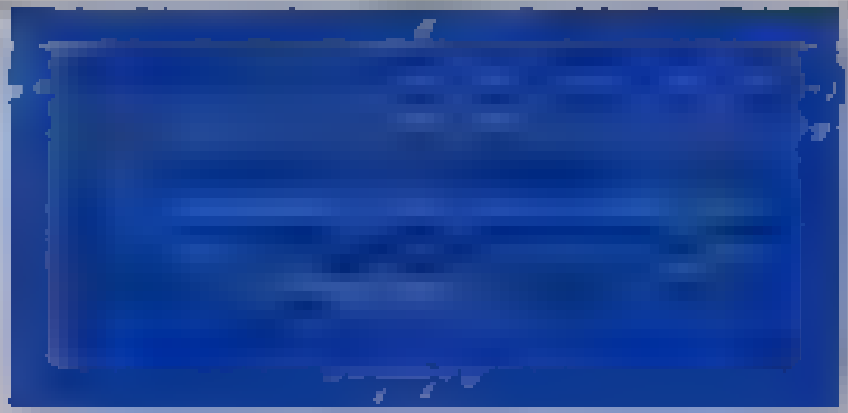


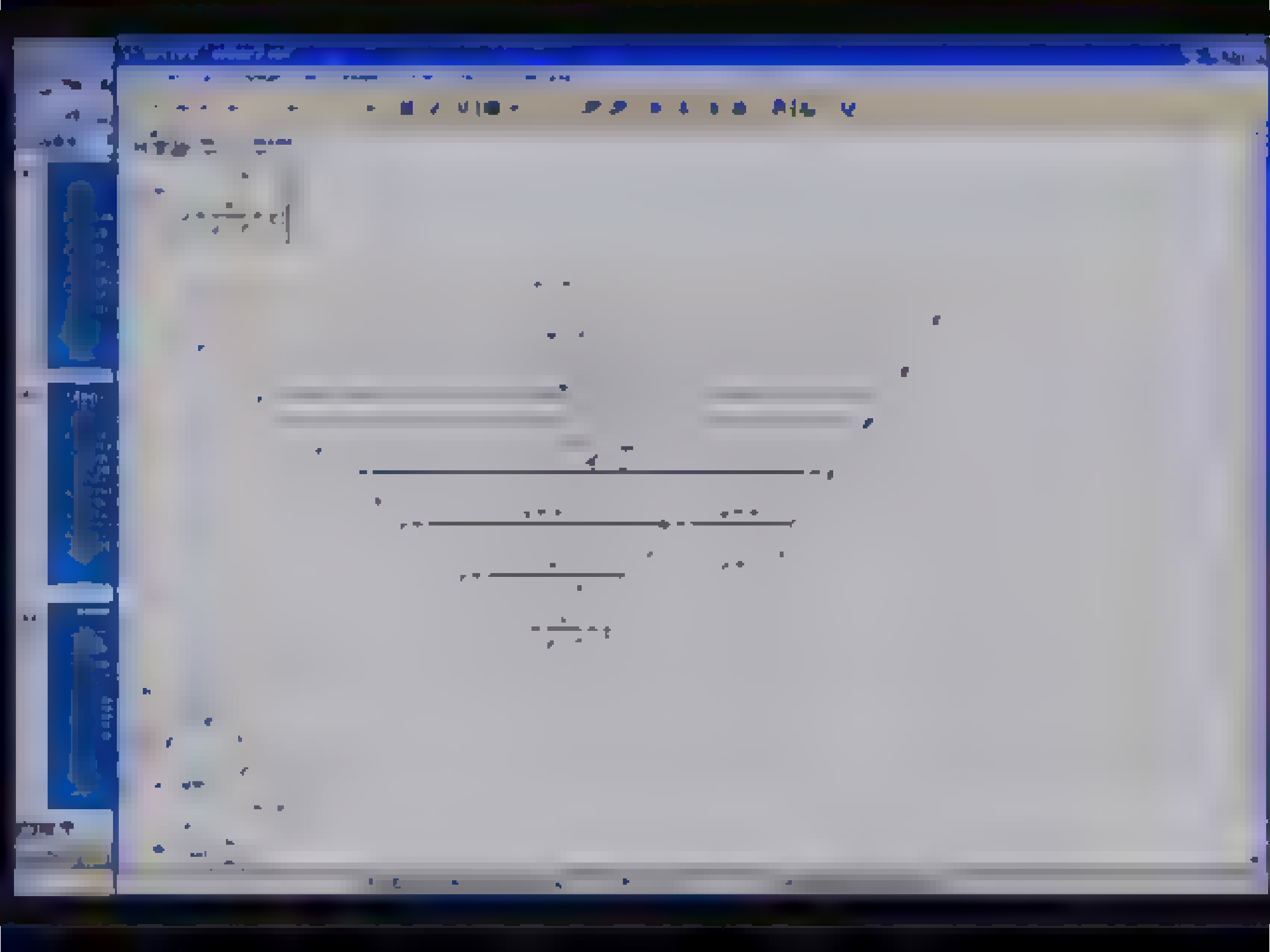
Demo

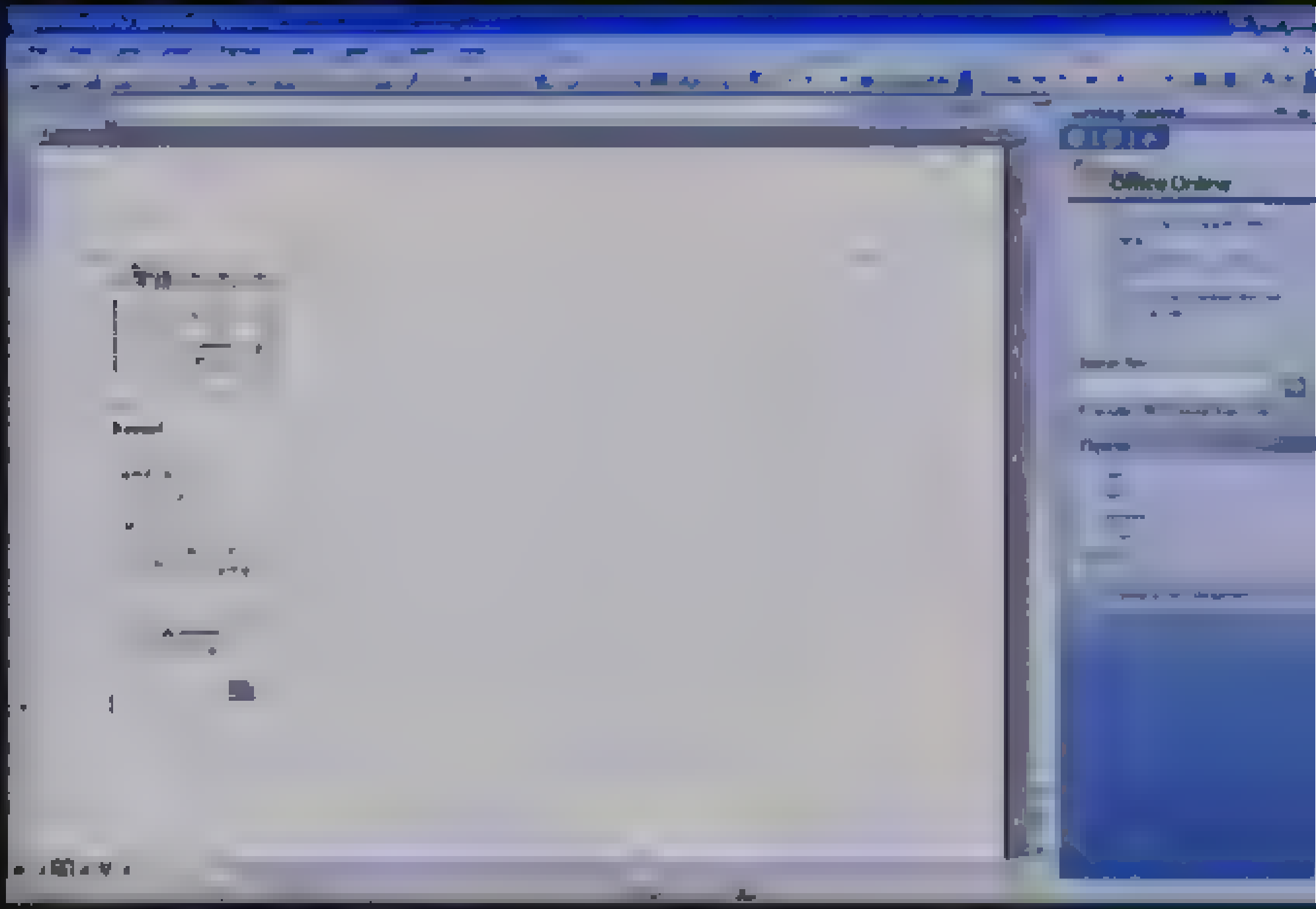


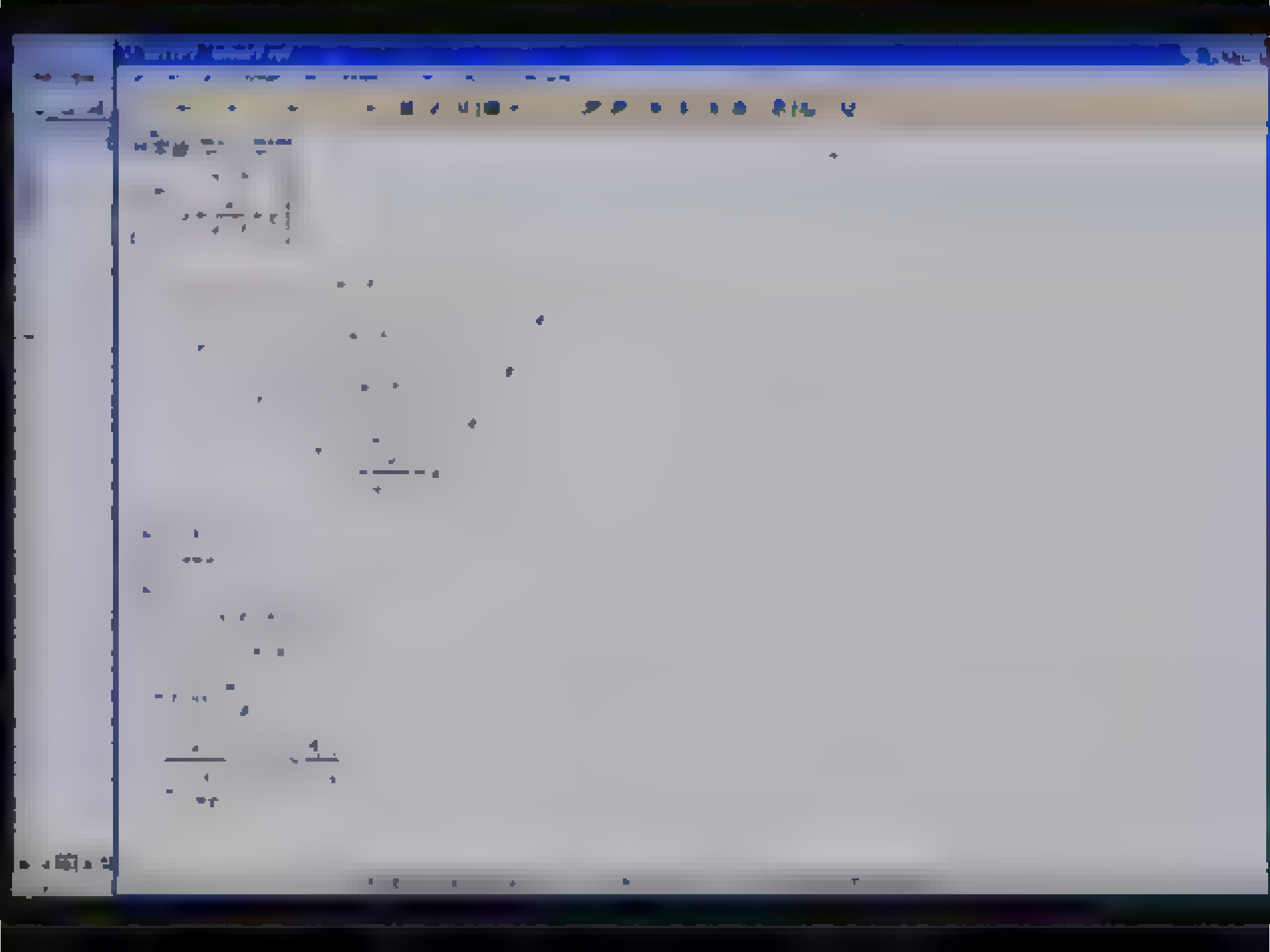
Where else?

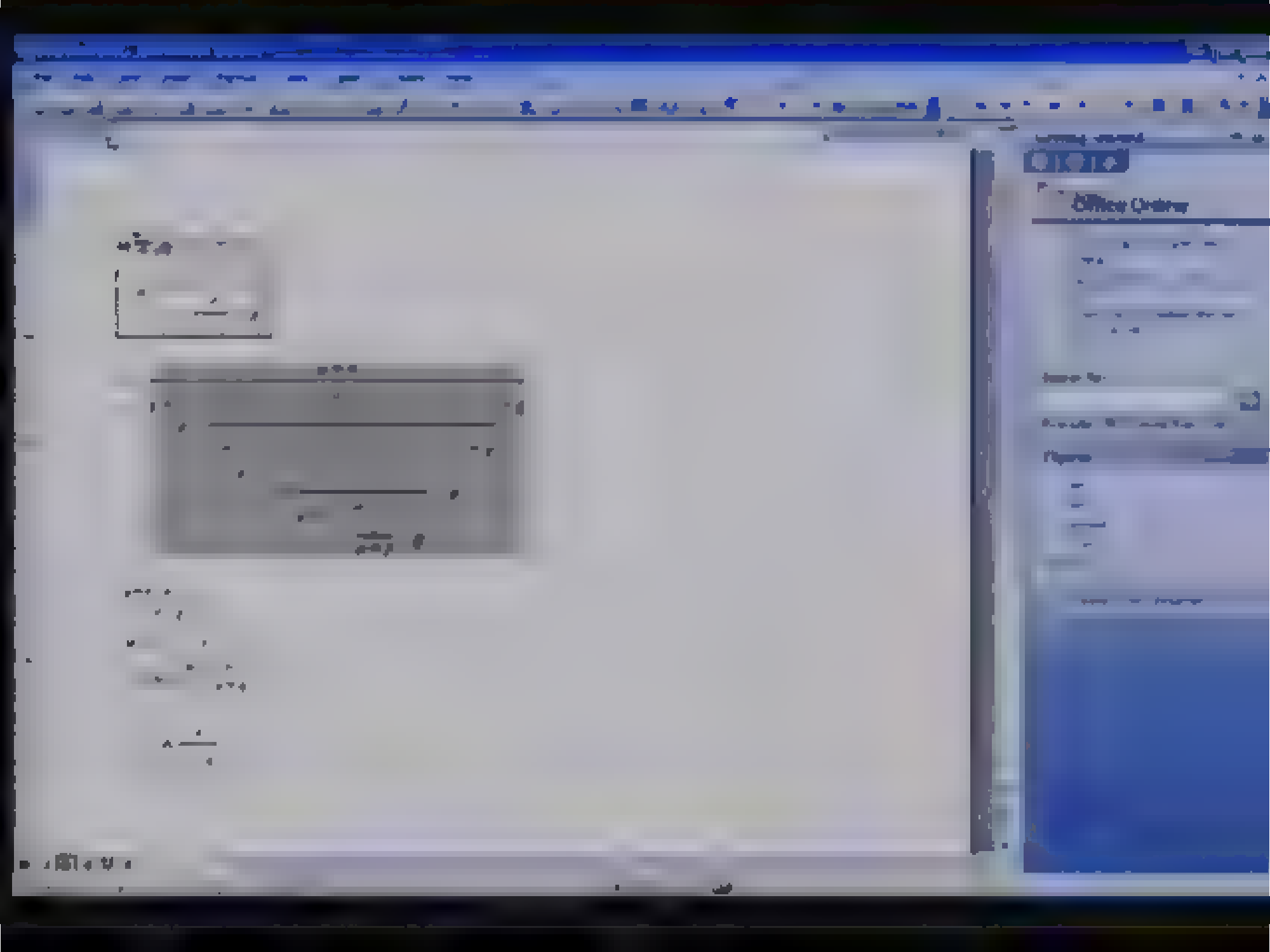


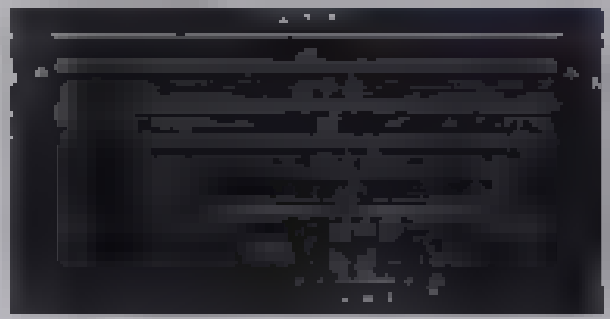


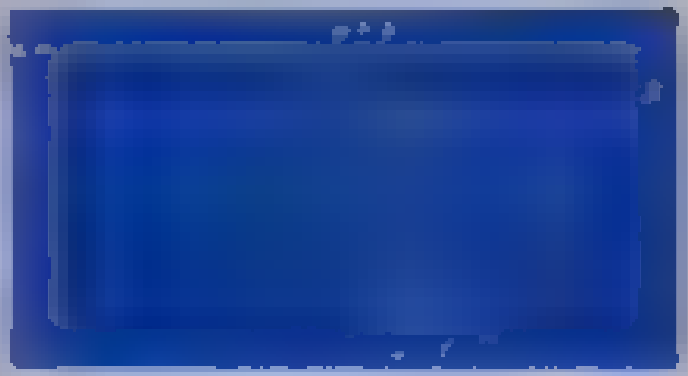


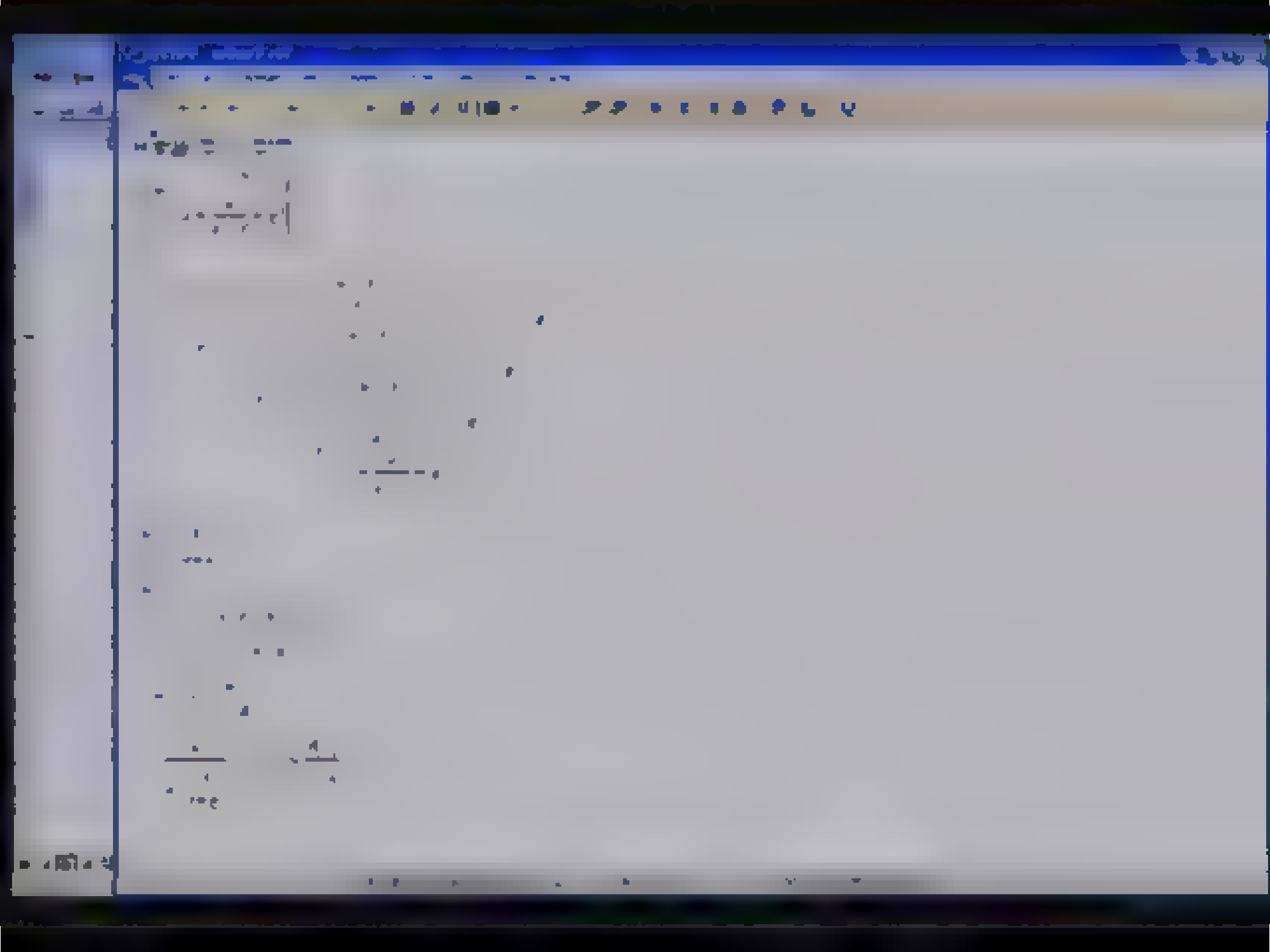

Office Online

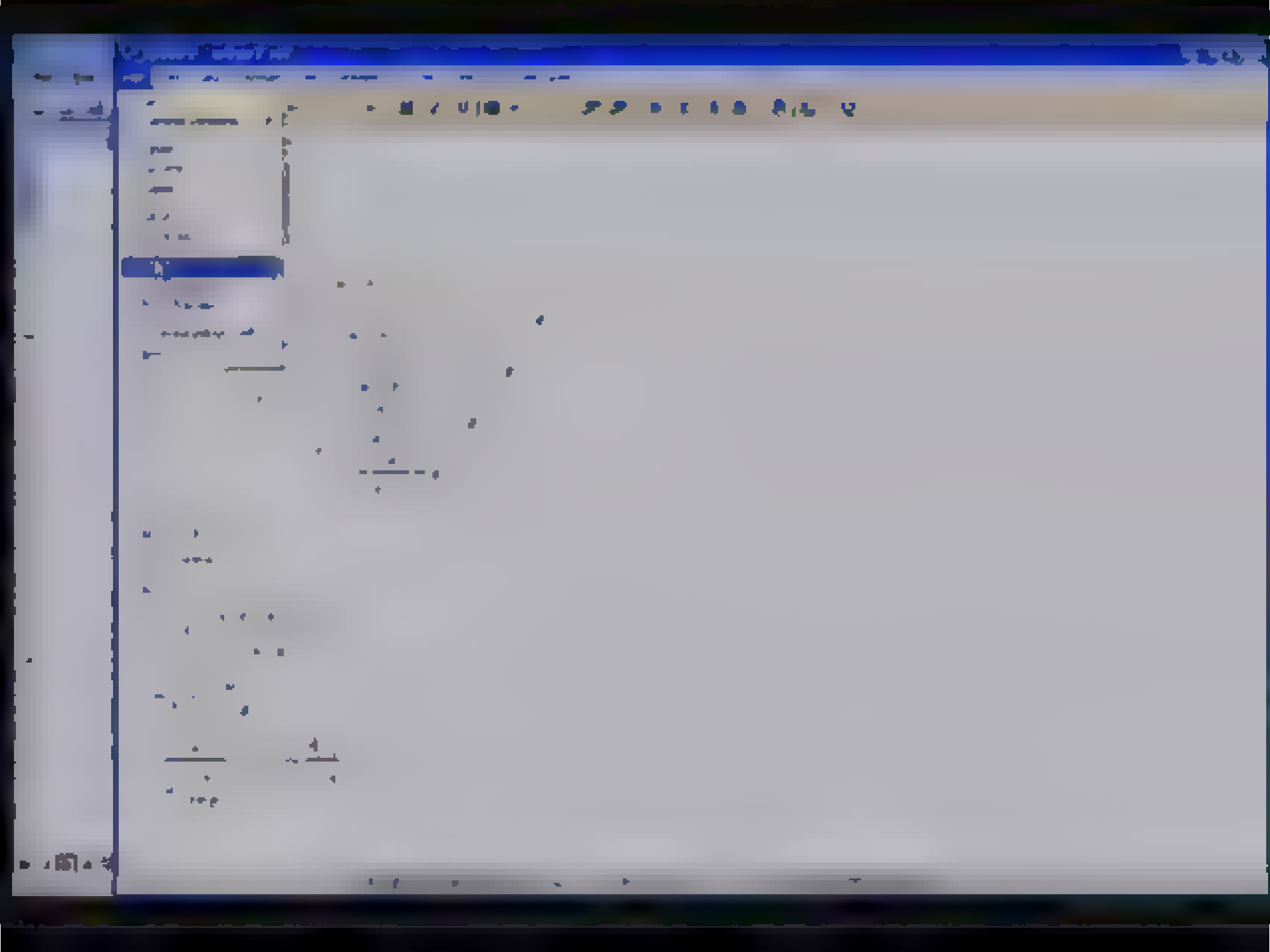


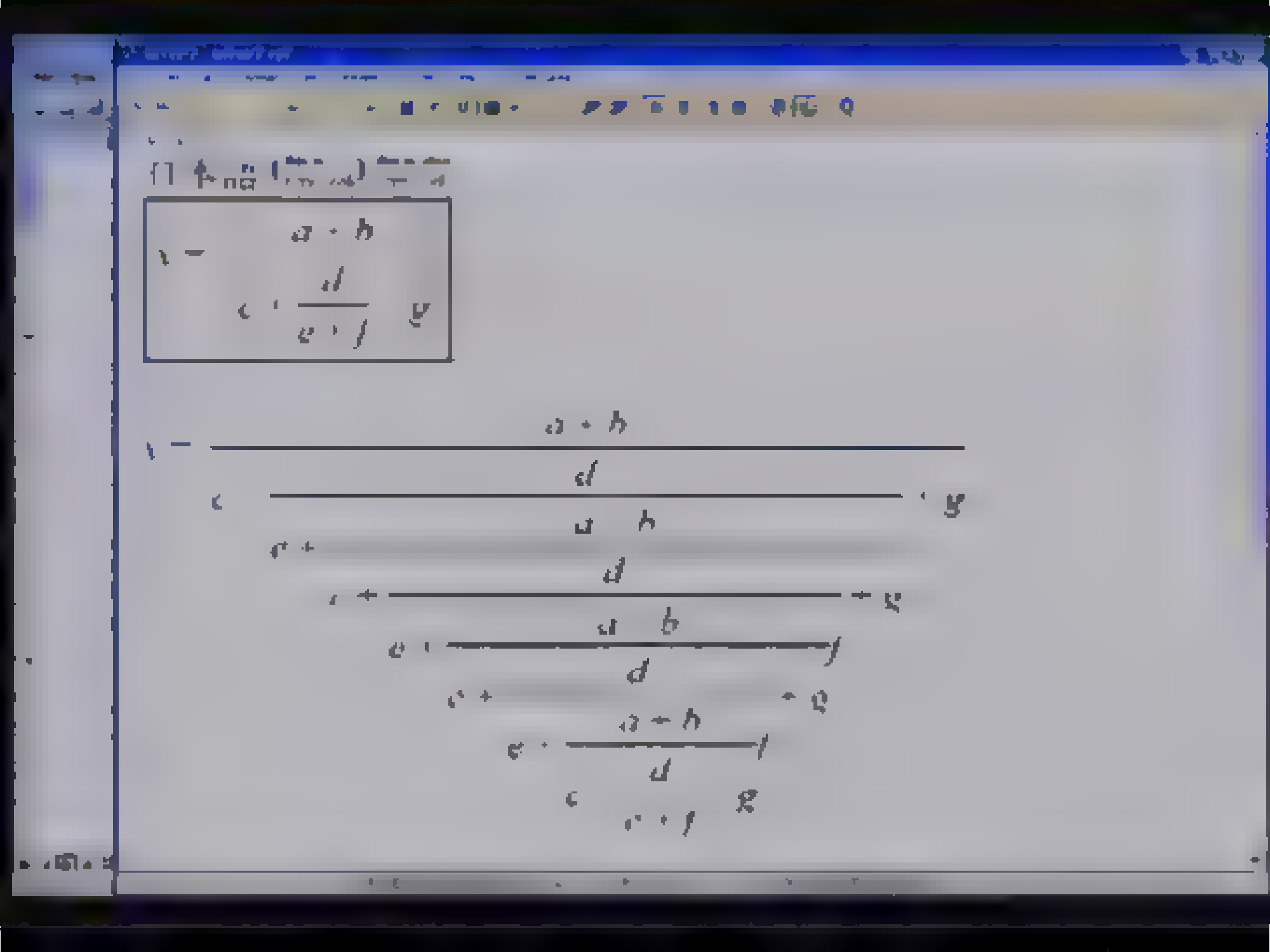


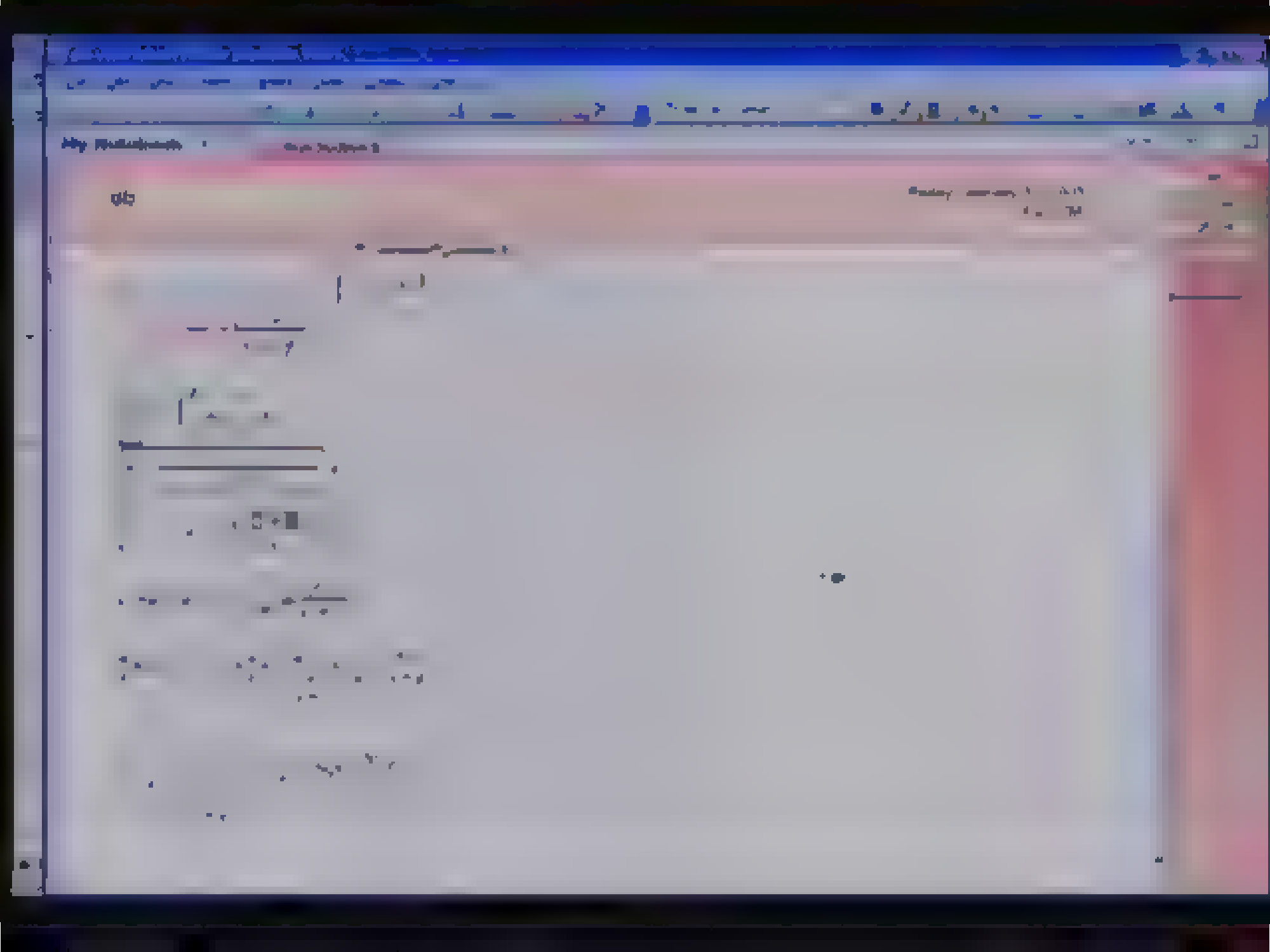


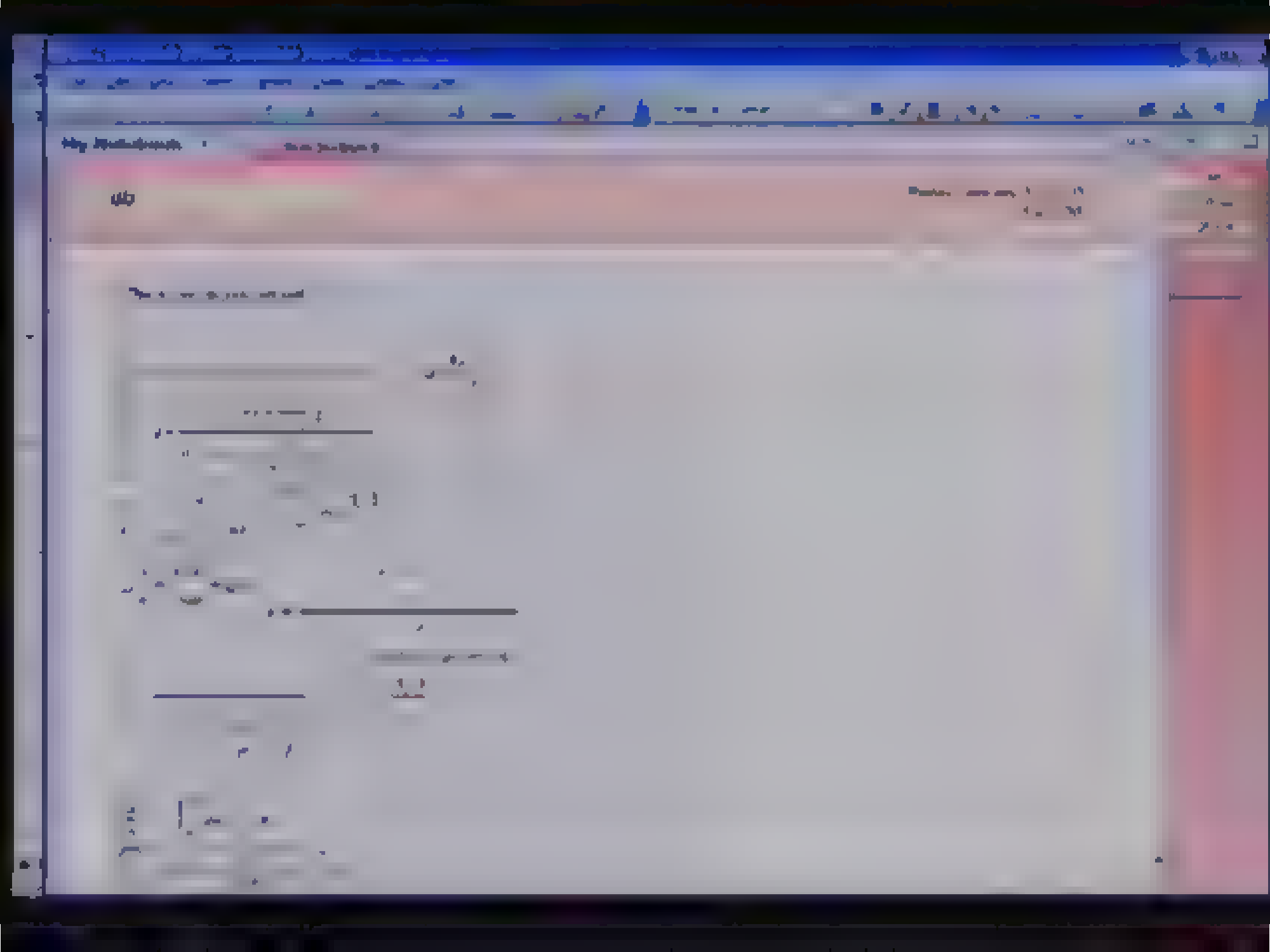


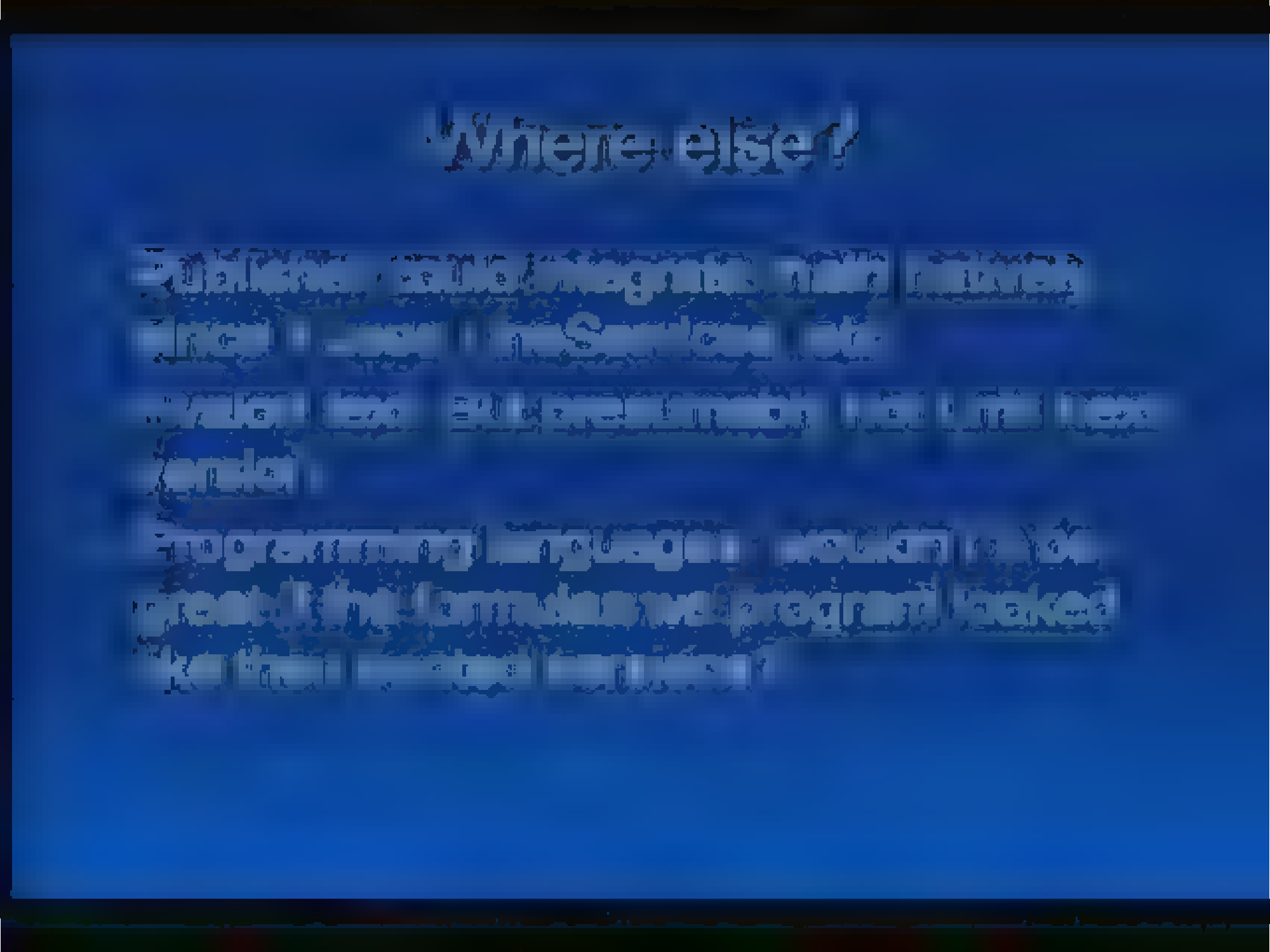




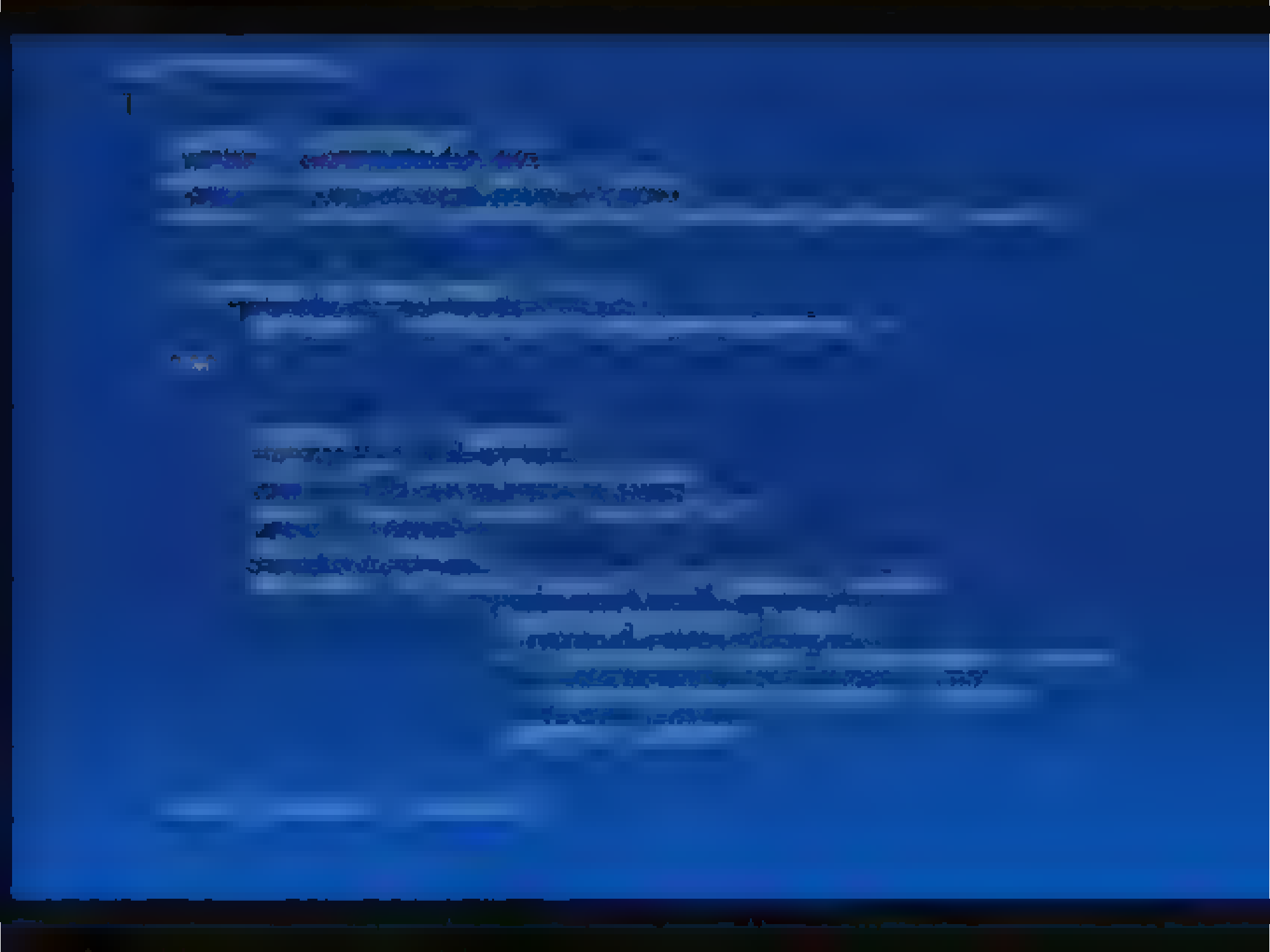


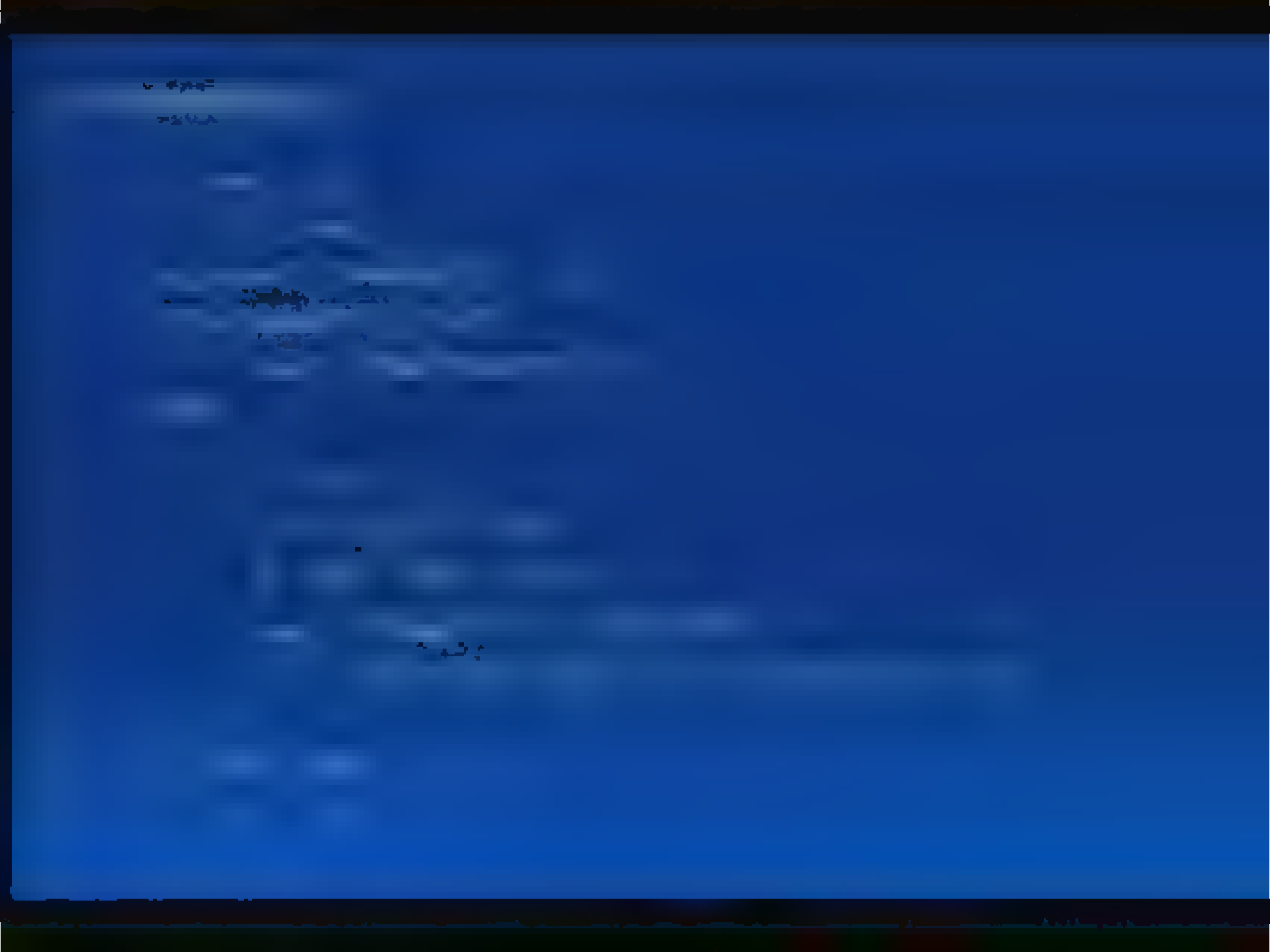





Where else?

Mathematics as a Programming Language





```
void IHBMWM(void)
{
        γ' = γ•√(1 + I₂);
        ν = γ + γ₁ + i•Δ;
        α_inc = α₀•(1 − (γ₁•γ•I₂/γ'))/(γ' + ν);
        if (!γ₁ || fabs(Δ•T₁) < 0.01)
                α_coh = −.5•α₀•I₂•pow(γ/γ', 3);
        else
        {
                Γ = 1/T₁ + γ₁;
                I₂F = (I₂/T₁)/(Γ + i•Δ);
                β = √(β² − ν•(ν − γ•I₂F));
                α_coh = .5•γ•α₀•(I₂F(γ + ν)/(γ'•γ' − β²))•((1 − γ/β)•(β − ν)/(β + ν) − (1 − γ/γ')•(γ' − ν)/(γ' + ν));
        }
        α₁ = α_inc + α_coh;
}
```

References

- *The Unicode Standard, Version 4.0*. Addison-Wesley (2003)
- B. Beeton, A. Freytag, M. Sargent III, *Unicode support for mathematics*, http://www.unicode.org/reports/tr25/ (2003)
- D. E. Knuth, *The TeXbook*, Addison Wesley (1986)
- L. Lamport, *LaTeX*, Addison Wesley (1994)
- MathML 2.0 is documented at http://www.w3.org/Math/ (2003)

Conclusions

- 8 infrastructures allow us to do math display and editing better than ever
- High quality LineServices math handler enables better typography than TeX
- Streamlined input methods facilitate math entry
- Incorporate into Word 12, OneNote 2.0, RichEdit, PowerPoint, IE, … and maybe future compilers